PRELIMINARY

A Meta-Analysis of Money Demand

Markus Knell and Helmut Stix*

Oesterreichische Nationalbank

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Abstract

In this paper we perform a meta-analysis of empirical money demand studies involving more than 500 individual money demand estimations and analyze whether the wide variety of results can be explained by characteristics of the studies. We find that estimates for the income elasticity of money are systematically and significantly higher if broader definitions for the monetary aggregate are used. The inclusion of wealth tends to cause lower estimates. In addition, we also investigate the impact of various other variables, econometric methods, details of the specification and macroeconomic variables on the size of estimated income elasticities and. Our overall conclusion is that the wide variety of estimated income elasticities can only be partly attributed to the imprecision of estimation, differences in the study characteristics and to different macroeconomic environments.

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* Oesterreichische Nationalbank, Economic Studies Division, P.O. Box 61, A-1011 Vienna. markus.knell@oenb.co.at, Phone.: [+43]-1-40420-7218, Fax: [+43]-1-40420-7299. helmut.stix@oenb.co.at.

1 Introduction

Money demand is certainly one of the best researched fields in economics. Literally thousands of articles have been published over the last decades that contain empirical money demand estimations for numerous countries and time periods. However, despite these considerable efforts the results of this huge literature are quite diverse. The range of the estimated income and interest-rate elasticities is wide and while some papers maintain that money demand is stable others come to the converse conclusion. In an international sample of studies analyzed in later parts of this paper, income elasticities between -14.11 and 44.79 (or—corrected for outliers—between 0.01 and 2.46) are observed and even for the same country and time period sometimes substantial differences can be found (cf. Ball 2001). Most surveys of money demand studies find a similar diversity (cf. Fase 1994, Sriram 2001): "The present survey hardly shows any convergence of empirical findings, with clear outliers for certain coefficient values. This leads to the conclusion that the theoretical simplicity of the demand for money fades away in an empirical approach and raises doubts on the stability of estimates" (Fase 1994, 433).

However, the existing surveys on this topic have more or less confined themselves to the study of the point estimates of crucial parameters where the finding of a large diversity of estimation results is interpreted as indicating instability of money demand (cf. Fase 1994, 436f.). In our view, this conclusion seems to be somewhat premature because it overlooks—partly or completely—a number of factors that could be responsible for the variation of estimates. First, the distribution of point estimates reveals nothing about the precision of estimates. For example, an extreme point estimate does not necessarily imply that a particular value, like the unitary income elasticity associated with the quantity theory, is not contained in the respective confidence interval. Second, the wide variety of point estimates might be due to the fact that studies differ from each other in various important dimensions, including the definition of monetary aggregates, scale variables, deflators, the inclusion or exclusion of specific interest rate and asset price variables and of proxies for wealth, financial innovation. Money demand theories suggest that various of these factors

should have an impact on the estimations (e.g. that the income elasticity should be higher for broader monetary aggregates) which could explain the diverse results. Furthermore, studies also differ by the estimation method.[1] An analysis of the implications of these studies should be based on comparable models, which requires to control for all of these factors. This is barely possible in qualitative surveys. Finally, one could speculate whether the variability of estimations can be explained by different macroeconomic situations that prevailed during the observation periods of the individual studies. A highly volatile economic environment (e.g. strongly fluctuating inflation and interest rates) might lead to less precise estimates and might arguably even be associated with a systematically different money demand structure than a more stable economic environment. A thorough investigation of these issues thus seems to be advisable before making a final judgment about the presence or absence of a predictable, intertemporally and internationally comparable structure of money demand and about the reliability of money demand estimations.

In this paper we deal with these aspects in turn. First, we analyze both the frequency distribution of more than 500 individual point estimates of income elasticities as well as the frequency distribution of the confidence intervals implied by the point estimates. We find that individual confidence intervals are typically rather narrow and do not have large overlaps—not a single income elasticity, e.g., is included in more than half of all 95% confidence intervals. Therefore, imprecision cannot explain the wide diversity in point estimates. So, we go one step further and analyze whether and to what extent different characteristics of the individual studies can explain the wide-spread results. To this end, we undertake a meta-analysis of money demand studies involving again almost 500 individual estimations. By summarizing these estimations in a systematic, quantifiable and

[1]Previous surveys mostly have analyzed papers that were written before the boost (or, at least at an early stage thereof) of the new techniques that deal with long-run properties of time series, like cointegration analysis. Undoubtedly, these methods have immensily influenced the way how empirical money demand studies are conducted. For example, the majority of empirical papers discussed in Fase (1994) employs partial adjustment models and only 1.5% of all studies use cointegration techniques. In our sample of papers, the partial adjustment models have almost disappeared. In light of this development, it is of interest to study whether and how the general findings of studies that used earlier methods compare with those of newer studies.

multivariate manner, meta-analytical methods allow to detect similarities across studies—similarities that hold irrespective of the country, the time period, the estimation method or the money demand specification. Finally, we turn to the question whether in addition to the study characteristics the income elasticities are also influenced by certain macroeconomic conditions (state of economic development, volatility of the macroeconomic environment etc.).

The findings of the meta-regressions can be summarized as follows. In line with theoretical conjectures, the meta-regressions yield that broader monetary aggregates lead to consistently higher point estimates of the income elasticities while the inclusion of variables that stand for wealth tend to decrease them. Other variables, like the choice of scale variables, specification in terms of nominal money, the estimation method, etc. are also found to exert a significant influence on the income elasticity estimates. However, the significance of these variables depend on the subsample used. Furthermore, for narrow money we find a significantly negative correlation between the size of the income elasticity estimates and the inflation rate. For broad monetary aggregates, our results suggest no systematic impact of macroeconomic variables. However, the precision of the point estimates (as a measure of stability) decreases in highly volatile environments and when important variables are strongly collinear over the observation period.

Although the meta-regressions are able to explain a substantial percentage of the variation in the income elasticity estimates, a large part of the diversity in point estimates remains unexplained. Thus, the wide variety of estimated income elasticities can only partly be attributed to imprecision of estimation, differences in the study characteristics and to different macroeconomic environments. In light of these results, our overall conclusion is, that the assumption of a money demand function that is stable over time and across countries seems hard to justify.

The paper is structured as follows. In the next section, a brief overview of existing money demand theories is given. In section 3, we describe the principles of meta-analyses, present our data, study the precision of point estimates and develop hypotheses about possible influences on the income elasticity of money demand. In section 4, we test these

hypotheses by undertaking a meta-regression analysis and we discuss our results. In section 5, the influence of certain macroeconomic variables on the magnitude and precision of the income elasticity estimates is investigated. Section 6 concludes.

2 Theoretical Background

The starting point in most of the empirical literature on money demand is a specification of the form:

$$m_t - p_t = \gamma_0 + \gamma_1 y_t + \gamma_2 i_t^{own} + \gamma_3 i_t^{out} + \gamma_4 \pi_t + \gamma_5 w_t + \gamma_6 X_t + \varepsilon_t, \tag{1}$$

where $(m_t - p_t)$ is the logarithm of real money demand[2], y_t is the logarithm of the scale variable, i_t^{own} (i_t^{out}) stands for the nominal rates of return on financial assets included in (excluded from) the definition of the monetary aggregate, π_t for the rate of inflation, w_t for wealth and X_t for a vector of other variables that—according to specific theories or to the conjecture of the respective author—might have a systematic impact on aggregate money demand. Virtually all money demand theories expect a positive sign for γ_1 while there exists less agreement about its size. According to quantity-theory-based approaches it should equal unity whereas inventory theories, e.g., come to the conclusion that it should be significantly lower.[3] In general equilibrium approaches (as propagated, e.g., by Milton Friedman) the demand for money of an individual depends on all (intratemporal and intertemporal) prices and on his or her wealth, including money, bonds, shares, real assets and human capital. An implication of this theory is that the income elasticity of (broad) money can be different from 1. A growth in income might well lead to an excessive increase in the demand for financial assets, including holdings of money. In this view (broad) monetary assets are, so to say, a luxury good with an income elasticity of $\gamma_1 > 1$.

[2]Some papers estimate nominal instead of real money, meaning that the LHS of (1) is m_t while the RHS contains as an additional regressor $\gamma_7 p_t$.

[3]In the seminal papers by Tobin (1956) and Baumol (1952) the income elasticity is 0.5, in other variants of the inventory model (e.g. Miller & Orr 1966) it ranges from 1/3 to 2/3.

A further implication is that wealth should be an important additional determinant of money demand, thus suggesting that $\gamma_5 > 0$.[4] With the notable exception of the quantity theory in its most basic form almost all theories of money demand (e.g. the liquidity preference theory, the portfolio approach, etc.) allow for a sometimes crucial role of asset prices, in particular of interest, inflation and exchange rates. The expected signs for the various asset price coefficients in (1) are $\gamma_2 > 0$, $\gamma_3 < 0$, $\gamma_4 < 0$ and possibly $\gamma_2 = -\gamma_3$.

As this brief discussion shows, money demand theories arrive at quite different conclusions and testable hypotheses when it comes to the importance and predicted effects of various explanatory variables. In the following section we will discuss some of these implications and hypotheses more extensively and we will subsequently test them in the framework of a meta-regression analysis. Before turning to this, however, we want to first comment on the method and data used.

3 Empirical Methodology, Data Description and Some Hypotheses

In the following we want to first briefly describe the principles of meta-analyses and we will outline our procedure for paper selection, study retrieval, coding and estimation. Subsequently we will present descriptive statistics of the studies and their characteristics and we will develop some hypotheses how the latter could be expected to influence the results.

3.1 The Concept of Meta-Analysis

"Meta-analysis" is the collective name for quantitative methods of combining the results of previous separate but related studies on a specific topic to synthesize summaries and conclusions. "Meta-analysis can be understood as a form of survey research in which research reports, rather than people, are surveyed" (Lipsey & Wilson 2001, 1). The "surveyed pa-

[4]The Keynesian money-demand model also predicts a dependence on wealth since the latter determines an economy's total demand for financial assets (cf. Laidler 1993, 54f.).

pers" can then be statistically examined in order to investigate whether variations in the results can be explained by the specifc characteristics of the individual studies. A special form of a meta-analysis is a meta-regression analysis, where "the dependent variable is a summary-statistic, perhaps a regression parameter, drawn from each study, while the independent variables may include characteristics of the method, design and data used in these studies" (Stanley 2001, 131f.). Thus, the difference to the more traditional surveys on a specific topic ("narrative literature reviews") is that the meta-analysis involves less subjective reasoning and judgemental arguments about what represents an acceptable empirical method, a "state-of-the-art" treatment of the question at hand, etc.[5] In out context, e.g., surveys on the empirical money demand literature normally stop after having presented descriptive statistics and histograms of the point estimates, at best separated according to one single dimension (like broad and narrow money, cf. Figure 1). A (multiple) meta-regression analysis, however, allows to jointly analyze the impact of various study characteristics on the point estimates, to compare and quantify these effects and to use statistical tools to test for their significance, etc. This multivariate framework should thus be better suited to find out whether empirical money demand estimations share common features and a comparable underlying structure which can shed light on open theoretical questions and pave the way towards a unified, commonsensical empirical money demand specification.

Over the past years a huge number of meta-analyses was conducted in medical and social sciences (e.g. involving analyses of clinical trials of new drugs and medications). In economics, however, only a handful of studies that rely on meta-analytical methods exist up to now (cf. Stanley 2001, 134). Most of them are in the field of labor economics, others deal with the returns to education or tests of Ricardian equivalence. The meta-regression analysis on money demand studies conducted in this paper is—according to our knowledge—the first meta-analysis in the field of monetary economics.

[5]This is concisely summarized in the title of a recent book on the history of this method: "How Science Takes Stock".

3.2 Data

The first step in undertaking a meta-analysis involves the retrieval of relevant studies. Here it is important to use a search and selection method that is as objective as possible in order to avoid possible selection and availability biases. We searched in July 2002 in the EconLit Database for articles that met certain criteria. In the end we are left with a sample of 79 papers published in academic journals after 1994 that form our basic sample.[6] Most of these studies contain more than one money demand estimation yielding a total sample of 631 estimations.[7] For each of these estimations we extracted and coded information about the estimated coefficients and about a wide range of potential explanatory variables (see Table 1).

The main topic of this paper is the wide variability of money demand estimations. This variability is again a multi-dimensional issue that is reflected, e.g., in differences in the estimates for the income elasticities, the interest rate (semi-)elasticities and other coefficients, number of cointegrating vectors found, the lag structure empolyed, etc. In this paper we focus on the most common and arguably the single most important parameter of money demand estimations, the income elasticity γ_1.[8]

A wide variety of estimates for the income elasticity of money demand is reported in our sample. This is summarized in Table 2. Although these figures refer only to uncon-

[6]First we looked for entries that contained the words "money demand" and one of the following word parts: "empiric*", "estimat*", "stab*" or "instab*". In addition to this we required that studies were published in one of 232 leading economic journals and that they included an abstract (in order to check whether they include empirical estimates). This left us with a total of 386 papers. This number was further narrowed down by considering only papers published after 1994 that had either "mon* demand" or "mon* stability" in the title. After reading the abstracts of all remaining entries and excluding all papers that were not appropriate for our purpose (since they contained only theoretical models, cross-section analyses, purely econometric analyses, etc.) we arrived at a sample of 94 articles. During the process of coding another 15 papers were excluded (e.g. for missing empirical results) leaving us finally with 79 papers. A complete list of these papers is available from us upon request.

[7]We did not distinguish between the different estimations within a paper. Even if the authors changed, amended or discarded a certain specification we also left this equation in the sample following the suggestion that in a meta-regression analysis the differences in the results should (at least partly) be explained by the particularities of the specifications. We come back to this issue, however, when we turn to the question of weighting.

[8]In a follow-up study we turn to other aspects of the estimations including the information about stability tests that are conducted in a number of papers.

ditional means they already contain some interesting results. First, the average estimated income elasticity over all 559 usable models is 1.06 which is surprisingly close to the unitary prediction of the basic quantity theory specification. Second, however, there exists substantial variation both within the total sample and across various subsamples. For the total sample, e.g., the standard deviation is 2.1 and the estimates range from -14.11 to 44.79.[9] In order not to have our own results be dominated by implausible point estimates we discarded outliers.[10] This leaves us with an adjusted sample of 469 observations shown in the lower part of Table 2. The average income elasticity for this adjusted sample is now even closer to the focal point of 1, for OECD countries it is exactly unity, while Non-OECD have a significantly lower value (0.89). The average estimates for the US are considerably lower (0.84) than for Germany (1.16) or for multi-country studies of European economies (1.34).[11] This result is in line with similar observations in the literature where it is sometimes speculated that this might be caused by more pronounced economies of scale with regard to money holding in the US (cf. Fase 1994, 434).

Thus far, we have only looked at the point estimates of the various studies and we have discussed some of their statistical properties and how they vary across different subsamples. The wide diversity of results can also be illustrated in histograms. This is usually done in money demand surveys (cf. Fase 1994, Figure 1, Sriram 2001, Figures 1 to 3) and we perform a similar exercise for our sample in the left panel of Figure 1 where we have used kernel density estimations to "smooth" the histograms (separately for broad and narrow monetary aggregates). We see the expected peak at 1 and for narrow money

[9] Cf. on this FN 7.

[10] First we eliminated models where the income elasticity was restricted to be one without proper statistical testing. Afterwards we used an outlier elimination procedure based on the studentized residuals of our benchmark regression in Table 4. The adjusted sample shows no sign of non-normal or heteroscedastic residuals and the values of the included income elasticities now lie more reasonably between 0.01 and 2.46. Using the cruder method of eliminating outliers by simply discarding the estimates in the lower and upper five percentiles of our data, results in a very similar adjusted sample.

[11] The subsample "EU Multicountry" refers to studies that combine the data on various European countries to derive some aggregate money demand estimation. Thereby special emphasis has to be laid on the question how the data are aggregated (fixed exchange rate, flexible exchange rate or PPP method) and how cross-border holdings are treated (Wesche 1997). In our sample we have 44 EU Multicountry estimations, ranging from an EC-3 (Germany, France, the Netherlands) to an EMU 15 sample. Many of them were done in the run-up to the formation of EMU.

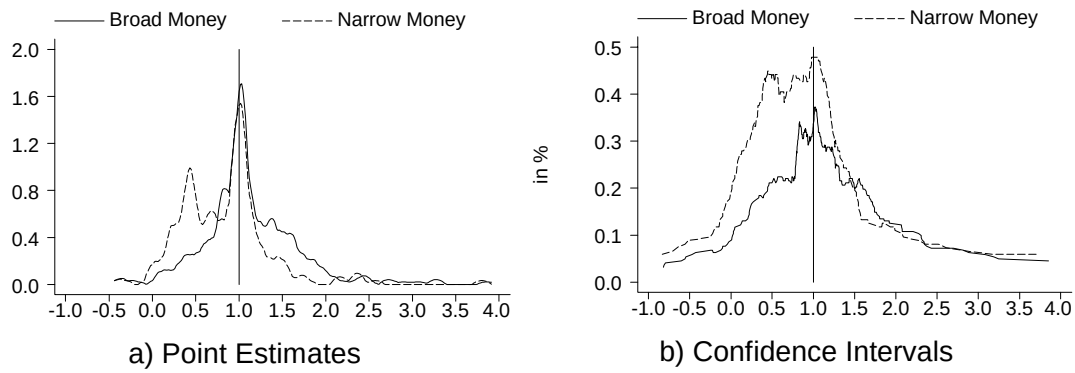

Figure 1: Smoothed Histogram of Point Estimates and Frequency Plot of Confidence Intervals

estimations also a second peak around 0.5. In addition, it is again clearly visible how strongly the point estimates of the income elasticities differ across studies. Interestingly, it is seldomly asked in money demand surveys whether this variation in point estimates is due to imprecise estimation or whether it is "genuine", i.e. reflecting differences in the underlying economic structure. This can be analyzed only if also the stochastic distribution of the point estimates is taken into account. For example, a peak at 0.5 does not a priori imply that a unitary income elasticity is rejected by the data since the value of 1 could still be included in most confidence intervals of the respective point estimates. Therefore, we have constructed frequency plots of confidence intervals (shown in the right panel of Figure 1) for which we have used the information of all studies that report some measure for the precision of estimation (standard errors, t-statistics or p-values).[12] The height of the curve indicates the sample frequency with which a certain income elasticity is contained in the respective 95% confidence interval of the 323 individual point estimates.[13] Quite surprisingly, this analysis shows that for broad money the value 1 is included in only 32% of these confidence intervals implying that for a majority of empirical money demand

[12]Unfortunately, this is not the case for all studies and thus the number of observations decreases in this case to 323.

[13]A value 0.45 for an income elasticty of 1 means, e.g., that 1 is contained in 45% of the confidence intervals of all studies.

estimations the predicition of the quantity theory is clearly rejeced.[14] In contrast, the value of 0.5 is contained only in 18% of all confidence intervals for broad money. For narrow money the values of 0.5 and 1 are included in 50% and 44% of all confidence intervals, respectively.

Figure 2 in the Appendix presents similar pictures broken down by various subgroups of countries and by monetary aggregates. Panels (a) and (b) show a comparison of OECD and Non-OECD countries for narrow money while panels (c) and (d) do the same for broad money.[15] For narrow money a value around 0.5 is contained in the majority of studies for OECD countries while for Non-OECD countries the most frequent value is 1. One possible interpretation of this result is that payment systems are less developed in Non-OECD countries making it thus more difficult to economize on money holdings when income grows. Interestingly the opposite is true for broad money, where 0.5 "dominates" Non-OECD studies while values of 1 (or above) are most often found for OECD countries. This could mean that the "luxury good character" of broader monetary aggregates is more pronounced in industrialized countries.

Summing up the discussion we can state that the first possible explanation for the huge variation in point estimates for the income elasticity is not particularly successful. The variation is not soley or primarily due to imprecise estimation and—taking the largest feasible sample (cf. Figure 1 (b))—not a single value for the income elasticity is contained in more than 50% of the confidence intervals. The discussion thus far, however, did not take the differences between studies explicitly and systematically into consideration. As the variation across subsamples and the different pictures for broad and narrow monetary aggregates indicate (cf., Figures 2) it could well be that the point estimates of the income elasticities are influenced by certain specific characteristics of the individual studies and that correcting for these particularities leads to a clearer picture. This is the issue to which we want to turn next.

[14]The peak of the curve is reached at an income elasticity of 1.02 which is contained in 36% of all studies.

[15]The group of OECD countries is strongly influenced by the US and analyzing the latter separately leads to similar pictures and results in this context.

3.3 Basic Hypotheses

Broadly speaking there are at least four factors that might be responsible for different estimated income elasticities γ_1 across studies: (i) different studies might use different concepts for the dependent variable, money; (ii) they might refer to different measures of the scale variable itself; (iii) they might include or exclude certain variables that are correlated with the scale variable thus leading to an omitted variable bias; (iv) they might be estimated by different econometric methods and techniques.[16] These issues are discussed in the following more extensively where we develop hypotheses about likely influences. In section 4 we will then use meta-regression techniques to investigate whether these hypotheses are confirmed by the data..

3.3.1 Definition of the Monetary Aggregate

Typically money demand equations use quite different definitions of the monetary aggregate (MA), ranging from rather narrow concepts like the monetary base and currency in circulation up to the broadest concepts like M_3 and M_4. The distribution of monetary aggregates employed in our sample is shown in Table 3. About 40% of all models use narrow concepts of money (MB, M_0 or M_1) while the rest takes broader aggregates. In Non-OECD narrow money concepts are used more often than broader concepts.

As dicussed above the choice of the MA is not innocuous for the size of the income elasticity. Various theories of money demand imply that the holding of money for transaction purposes involves considerable economies of scale. As mentioned above inventory approaches derive income elasticities between 1/3 and 2/3 thus implying that the income elasticity γ_1 estimated in models that use a narrow concept of money should be lower than where a broader MA is employed. For broader aggregates the inventory approach models are not directly applicable and economies of scale are less likely to be present. On the contrary, following the argumentation by Milton Friedman and others the income elasticity

[16] All of these possible influences are based on the assumption that (1) and its functional form is in fact an accurate description of the underlying money demand function. If this is not the case then (1) is misspecified and γ_1 could be influenced by a variety of other factors and variables.

for these MAs might well be larger than one. We can summarize these arguments in our first hypothesis.

Hypothesis 1 *Empirical money demand studies that use narrow concepts of money should lead to systematically lower estimates for the income elasticity than studies that use broad concepts.*

Some support for this hypothesis can already be found in Figure 1 (a) where the distribution of income elasticities for narrow money is more skewed to the right than the one for braod money. This, however, is only a "univariate" comparison and it is not clear whether it still holds if one corrects for other potential explanatory variabes.

3.3.2 Scale Variable

The quantity theory of money is normally formulated with regard to total transactions T rather than to total income Y. Since the total volume of transactions is difficult to measure most studies resort to some proxy for the scale variable, mostly GDP or national income, but sometimes also even smaller subsets like consumption or industrial production. In our sample 62% use either GNP, GDP or NNI while a minority of studies take consumption, industrial production or other measures (cf. Table 3).

The use of these measures, however, assumes that the total volume of transactions that give rise to the transaction demand for money and the employed scale variable move in lock steps over time. Usually that sounds like a reasonable assumption to make but there might be periods where it is likely to be violated: "For example, one might posit that consumption is more money intensive than other components of GNP, a hypothesis supported by some evidence." (Goldfeld & Sichel 1990, 320). For two studies both using GNP as their scale variables the first will find a larger income elasticity if the observation period for the first country was characterized by a shift in the composition of GDP towards more money intensive sectors. This discussion leads us to the following hypothesis.

Hypothesis 2 *The measurement of the scale variable should not have an impact on the estimated income elasticities except in cases where the composition of the volume of transaction changed.*

3.3.3 Wealth, Financial Innovation and Other Potentially Correlated Variables

Various theories of money demand assume that wealth plays an important role for the desire to hold monetary assets. Many studies, however, do not include measures for wealth[17] and in our sample only 2% do (see Table 3). Noting that (at least in the aggregate) current income and total wealth are very likely to be positively correlated the neglect of wealth would cause an omitted variable bias and lead to an overestimation of the income elasticity.[18] This can be expressed in the following hypothesis.

Hypothesis 3 *Money demand estimations that include a measure for wealth should—ceteris paribus—lead to lower estimated income elasticities than studies that exclude such a measure.*

Similar considerations can be made for any other variable that (i) is included in some and excluded in other money demand estimations, (ii) according to theory should have a systematic impact on money demand and (iii) is correlated with income over the respective observation period in a predictable or measurable manner. If these three conditions are fulfilled then the income elasticity estimates from the studies excluding the variables should contain a detectable omitted variable bias.

[17] It was argued, however, that consumption is closely related to permanent income and thus a good proxy for wealth (cf. Laidler 1993, 167).

[18] In the context of OLS this is straightforward to show. Assume that the true model is given by: $Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + u_t$, while the following model is estimated: $Y_t = \beta_0 + \beta_1 X_{1t} + v_t$. In our case X_{1t} represents income and X_{2t} wealth. It can be shown that OLS estimation of the second ("wrong") model leads to a biased estimate of the coefficient: $E(\hat{\beta}_1) = \beta_1 + \beta_2 \frac{Cov(X_{1t,}, X_{2t})}{Var(X_{1t,})}$. Because $\beta_2 \neq 0$ (according to theory) $\hat{\beta}_1$ will be biased unless X_1 and X_2 are uncorrelated. The direction of the bias thus depends on the sign of β_2 and on whether X_1 and X_2 are positively or negatively correlated.

A minority of studies, e.g., contains measures for financial innovations reflecting the view that changes in a nation's payment system and payment habits should alter the income velocity. Financial innovation is thereby proxied by a wide variety of variables including the number of ATMs, the dissemination of electronic payment cards, the ratio of currency to the total money stock, the ratio of population to bank offices, the degrees of monetizations and financial development in general, etc. Taking the dissemination of electronic payment cards as an example one would suggest that this innovation should tend to lower the demand for currency and other narrow concepts of money. Since on the other hand the distribution of electronic payment systems is likely to be positively correlated with national income the exclusion of proxies for these financial innovations will lead to an underestimation of the income elasticity. Other financial innovations, however, like bank concentration and the degree of financial development are probably better thought of as being proxies for the sophistication of available financial products which could well go hand in hand with a *larger* demand for (broad) money. In this case the exclusion of the respective financial innovation variables would cause an upward bias in the estimation of the income elasticity.

Hypothesis 4 *The exclusion of variables proxing for financial innovation could lead to an omitted variable bias in the estimation of the income elasticity. The direction of the bias depends on the exact nature of the financial innovation variables used in the respective studies.*

3.3.4 Econometric Methods

In our sample of empirical money demand results several estimation methods are used.[19] In Table 3 the use of the different models is summarized. A majority of the papers employs the Johansen method to estimate long-run money demand functions.

It is interesting to analyze whether these methods produce different point estimates for

[19]For an overview of the different models, the reader is referred to Maddala & Kim (1998) or Patterson (2000).

the income elasticities. Some papers which apply different methods suggest that this may indeed be the case. For example, Ball (2001) compares the income and interest elasticities obtained from various methods for two samples of U.S. data. For the first sample ranging from 1946 to 1987, he finds point estimates for the income and interest rate elasticity which vary widely across estimators. However, when the sample is extended to 1996, the point estimates are much more clustered.[20] This suggests that, depending on the sample period, the estimation method might but need not influence the results. Evidence for the former case is, e.g., also mentioned in Wolters, Teräsvirta & Lütkepohl (1998) who compare for German data the point estimates obtained with the Engle-Granger method, fully modified OLS, dynamic OLS, an autoregressive distributed lag model and Johansen's method. Their finding is that "all methods that do not treat the dynamics explicitly (for example, the Engle-Granger method) or for which only a correction term based on a nonparametric estimate of the residual correlation (for example the Phillips-Hansen method) produce the highest income elasticities" (ibid., p. 402).

Overall, there does not seem to be a clear conclusion about the impact of the estimation method on the income elasticities that can be drawn from empirical papers. Probably, this is just the mirror image of the results obtained from Monte Carlo studies about the small sample properties of the various estimators. Maddala & Kim (1998) survey many Monte-Carlo studies and are able to find only a few points of agreement across these studies: "The unambiguous conclusions we can draw are that estimation of the long-run parameters by static regression is to be avoided [due to bias in small samples] and that the Johansen estimator (though showing less bias than the other estimators) exhibit large variation" (p. 183). Furthermore, Maddala & Kim (1998) argue that among single equation methods, an equation with leads and lags (like dynamic OLS or GLS) is to be preferred. The discussion about the influence of various methods is summarized in the following hypothesis.

[20] Ball (2001) regresses real M1 on Net National Product and on the (smoothed) commercial paper rate. He argues that the different result for the shorter sample is due to possible problems of multicollinearity between output and interest rates.

Hypothesis 5 *If the econometric model is correctly specified the method used for estimation should not have any systematic influence on the results asymptotically. In small samples the estimated income elasticities are likely to vary across estimators.*

Since the finding of differences in estimated income elasticities may reflect peculiarities of the sample and not differences in the estimators, it might also be important to control for sample effects when testing the above hypothesis. In the later estimations we therefore also include a number of additional variables like country dummies, time dummies, dummies for the data frequency and for the potential inclusion of dummies in the underlying regressions.

4 Meta-Results

In the meta-regressions the income elasticity estimated in study i is regressed on the set of explanatory ("meta-independent") variables that were discussed in the previous section. The results for a sample containing all observations are summarized in Table 4 for four different specifications: column 1 reports the results of a specification without individual country dummies, while country dummies are included in the specifications of columns 2 to 4.[21] In addition to the OLS estimations in column 1 and 2, the results in column 3 and 4 are based on specifications which are estimated by weighted least squares.

The question of whether meta-regressions should be weighted is controversial (Weichselbaumer & Winter-Ebmer 2001, Wolf 1986, 39). Potential weighting schemes could exploit that some estimations are based on rather small samples while others cover a long time-span using many years of data, that some papers are published in top-ranked journals others in journals of a lower ranking, etc. There are many possible ways of weighting and any choice is to some extent arbitrary. To account for this issue, we use two different weighting schemes. In column 3, the weights are based on the sample size of the individual studies reflecting the idea that the "quality" of the point estimates should increase with the number of observations. In the context of studies on long-run money demand one could

[21] The coefficients for the country dummies are not shown in Table 4.

also argue that the estimates of the *long-run* income elasticity are the more accurate the longer the time span a study covers.[22] Following this line of reasoning we use the number of years a study covers as a weighting scheme in column (4).[23]

Altogether the results of the meta-regressions in Table 4 are quite similar and do not depend very much on the weighting scheme employed. The general message is that a non-negligible part of the variation of estimated income elasticities can be explained by characteristics of the studies like the definitions of the monetary aggregates, the scale variable, the inclusion of variables for wealth and financial innovation and of variables that capture the specificities of the estimation method. In the model without country dummies, 41% of the variation in the individual income elasticity estimates can be explained by variations in the explanatory variables. It is remarkable that this value is much higher (70%) for the model with country dummies in column 2.[24] Also, several tests reject the normality of the residuals for the model without country dummies but do not reject normality for the model with country dummies.[25] The significance of many of the individual country dummies thus implies that there are important differences between countries even if the individual study characteristics are controlled for. To some extent, this might be taken as evidence that money demand is difficult to compare across countries. Given this evidence, we include country dummies in all subsequent specifications.

The results of columns 2 to 4 in Table 4 lend support to hypothesis 1 that the income elasticity increases with the "broadness" of the used monetary aggregate. In all meta-regressions, we find that income elasticities are significantly higher when a broader monetary aggregate—a variant of M_2, M_3 or M_4— is used. In particular, the results show that the income elasticity of M_1 does not differ significantly from M_0 (the reference mon-

[22] In the unit root literature, some evidence suggests that the power of unit root tests depend on the span of the data rather than on the number of observations (cf. Maddala & Kim 1998, 129f.).

[23] This is different from the weighting scheme according to the number of observations where a study based on monthly data could get a high weight although it does not cover a long time-span and might even be dominated by short-run developments.

[24] The adjusted R^2 increases from 0.39 to 0.67.

[25] We apply the Shapiro-Wilk W test, the Shapiro-Francia W' test and the combined skewness and kurtosis test. All tests yield the same results, qualitatively. Furthermore, a White test rejects homoscedasticity.

etary aggregate). M_3, M_4 and all variants of M_2 are not only different from M_0 but also from M_1. Within the group of broad monetary aggregates, the income elasticity of M_4, M_{MZM}, M_{M2M} are significantly larger than those of M_2 and M_3, where the latter two concepts yield the same income elasticities, statistically.[26]

Interestingly, the coefficient of nominal money is statistically significant in all specification implying that point estimates of income elasticities increase, on average, by 0.3 if a money demand specification is estimated in nominal terms.

The results for the scale part indicate that the choice of the scale variable signifcantly affects income elasticities. Studies that use consumption or (production) indices as a scale measure seem to produce significantly higher estimates of the income elasicity than studies that use GNP, GDP or NNI (our base categories), while the use of expenditure variables results in lower point estimates. As stated in hypothesis 2 it is not obvious how the definition of the scale part should play a role—our interpretation of the positive sign of consumption (or consumption and production indices) is that measuring changes in consumption expenditures might underestimate the development of total transactions thereby introducing an upward bias in the estimated income elasticities. The opposite holds for expenditures.

Studies that include a variable for wealth have a significantly lower estimated income elasticity. This is again the expected result that confirms hypothesis 3. Wealth plays a role for people's demand for financial assets (including broad money) and since income and wealth are typically highly correlated the omission of wealth from the money demand estimation leads to a considerable overestimation of the income elasticity.

The inclusion of variables that proxy for financial innovations do not seem to influence the estimated income elasticities in a predictable manner. In general the impact is negative but not statistically significant.[27] As expressed in hypothesis 4 this would mean that the proxies are more related to innovations in the payment system, etc. rather than to

[26]This is not surprising as the definitions of $M2$ and $M3$, depending on the country, often comprise similar assets.

[27]In the misspecified model of column 1 (without country dummies) financial innovation is significant. We suspect that this variable mistakenly captures a country effect and is therefore significant.

innovations that facilitate the investment in financial assets. The significance of the dummy for the time period over which money demand was estimated (Time)—the earlier a sample starts, the higher the income elasticity—could also reflect the steady increase in financial innovations over time.

Turning now to hypothesis 5 we find some support that the estimation method has a systematic impact on the results of the money demand estimations. First, the random coefficient method, and to a lesser extent the ADL method, generate lower point estimates than system methods (the Johansen and the CCR method serve as reference dummies). Also, FMOLS produces larger point estimates than ADL. However, since we have only a small number of studies in our sample that use the random coefficient method, the corresponding negative coefficient might also capture some other (omitted) characteristic(s) from these studies. Furthermore, as will be discussed below, the effect of the estimation method varies substantially across subsamples, precluding a general statement about the effect of a certain method on the estimated income elasticity. However, we think that the result suggest that it is highly advisable not to rely too much on a single method but to apply additional methods. Interestingly, this "robustness check" is done in only 30% of all papers in our sample.[28]

The use of monthly and of annual data results in lower estimates for the income elasticity than studies that employ quarterly data (the reference group). We have no good explanation why this might be the case and we can only speculate that probably the frequency of the data determines the degree to which the results on long-run money demand are disturbed by short-run influences. There is also some evidence that inclusion of dummy variables in the money demand specification increases the estimated income elasticity.

In Table 5 we have summarized the means of the predicted values for sub-groups and some individual countries. In contrast to narrative surveys, meta-analysis allows to compare the predicted values across countries by using a common benchmark specification to calculate the predicted values. In particular, the reported numbers represent the average

[28]Out of these 30%, two thirds apply two and one third more than two methods.

income elasticities one obtains if a model is estimated in real terms, with GDP as the scale variable, without wealth, financial innovation and dummies, with quarterly data and with Johansen's method. Furthermore, since the country specific effects are likely to be different for broad and narrow money, the predicted values are based on separate regressions for narrow and broad money (not reported).

For the total sample, the average predicted value for the income elasticity for narrow money is 0.93. For broad money, the average income elasticity is considerably larger (1.30). This holds for all subsamples and country groups analyzed. Thus, there is supportive evidence that broader monetary aggregates might be a "luxury good" implying an income elasticity > 1. The income elasticities for almost all subgroups is smaller than one, which might be explained by the presence of economies of scale for narrow money. Notable exceptions are found for EU Multicountry studies and, due to the low number of observations with some caution, for Germany. This result, which, again, is based on the assumption that the underlying models are comparable, thus confirms statements that can be found in qualitative surveys of the literature.[29]

Furthermore, as shown in Table 5, the average predicted income elasticity for narrow money is only slightly lower for OECD than for Non-OECD countries. Within the group of OECD countries, the average predicted income elasticity is considerably smaller in the US (0.61) than in other OECD countries (0.95). This sizeable difference might reflect that M_1 serves mainly transaction motives in the US, as posited by Fase (1994). We will provide some evidence on this below.

For broad money, we find a somewhat similar picture: First, the income elasticity of OECD countries is, on average, about the same as those for non-OECD countries and second, it is smaller for the US than for the other OECD countries.[30] In contrast to narrow money, the US and DEU seem to have about the same income elasticity for broad money. Also, there is a difference between DEU and both EU multicountry and other

[29]For example, "[b]roader definitions of money on the whole produce higher estimates of the income or wealth elasticity of the demand for money than narrower ones. [...] Studies using a narrow definition of money are more prone to yield income or wealth elasticities of demand below unity." (Laidler 1993, 169).

[30]This holds irrespective of whether EMU-Studies are included in the sample of OECD studies.

EMU countries. For the latter two groups, the income elasticity is found to be around 1.40 while for DEU an average of 1.18 is found. It is interesting that the estimated income elasticities for EU Multicountry studies is higher than that for DEU although Germany is contained in all multicountry studies, in many of them with a high weight (in particular in those studies that aggregate only few countries). Although not done in this study, it would be of interest to analyze whether this finding is genuine or whether it represents characteristics of the study, like the type of aggregation used.

To check for the robustness of the meta-regression, we analyze different country groups and different subsamples. For these regressions (Table 6), we only report the results for the weighting scheme that is based on the number of years covered by a study (cf., Table 4, column 4).

Columns 1 to 6 summarize the estimation results for various country subsamples. In general, we find that the specification seems to yield plausible results apart for the German sample (column 5) and, to some extent, for the sample of EU Multicountry studies (column 6). Both specifications are, however, based on a rather small number of observations (43 and 44, respectively). Therefore, we focus on the other subsamples (columns 1 to 4).

For the effect of the chosen monetary aggregate, very similar results as in our basic meta-regressions in Table 4 are obtained. That is, the income elasticity is significantly higher for broader monetary aggregates. Also, the coefficient of wealth remains negative and significant.

The results for the scale variables show that consumption is signifcantly positive in all subsamples. Also, the results in Table 6 reveal that the significance of (production) indices is due to the US sample while the role of expenditure stems mainly from Non-US studies. The significant role of observation time can be found in the sample of OECD but not in Non-OECD countries. This might reflect the fact that financial innovation mainly occured in OECD countries. Independent of the subsample, the use of monthly data results in lower point estimates. The role of dummies can be traced to Non-US studies. Furthermore, the effect of the various estimation methods differs across subsamles.

Although there are differences in the significance of the explanatory variables among

subsamples, it is striking that for most variables the signs of the estimated coefficients remain unaffected. For example, this holds for all scale variables, for wealth, for observation time, for monthly data, for the effect of dummies, for various estimation methods and with only one exception for all monetary aggregates.

Another robustness test deals with the potential problem that papers which contain a large number of estimations might dominate the results in Table 4. In fact, four of our 79 papers—each containing more than 23 individual estimations—cover 30% of our total sample. When we exclude these papers (Table 6, col. 8), the results are qualitatively unchanged, reassuringly. The same is true when we focus only on models that are estimated with the Johansen cointegration technique, arguably yielding a more homogeneous and comparable sample (Table 6, col. 7).

Summing-up we can say that the main conclusions of the basic meta-regressions in Table 4 seem to be quite robust across various subsamples.

5 The Role of Macroeconomic Variables

So far we have used the characteristics of the various money demand regressions to explain the differences in the estimated income elasticities. There remains, however, the possibility that these estimates are influenced by certain macroeconomic particularities of the respective observation periods that are not captured in the estimations and not in the meta-regressions conducted so far.

It is, e.g., often argued that during periods of high inflation the velocity of money increases and the income elasticity decreases, sinze people economize on their money holdings. Similarly it was argued that considerable uncertainties about asset returns (interest rates, inflation rates, exchange rates) will also tend to lower money demand of risk-averse consumers. Finally the general state of economic development could have an impact on the income elasticity if, e.g., money demand is not an iso-elastic function of income (as implied in (1))

In general one could think of many possibilities why and how macroeconomic variables

should have an impact on the size of the income elasticity. Either the neglect of certain relevant variables in the original regressions leads again to omitted variable biases (cf. FN 18) or the money demand relation is more complex than implied by the linear function in (1) which could have the consequence that the estimated income elasticities capture some of these non-linear relations. In any case we want to note that the detection of a significant impact of macroeconomic variables on the income elasticity suggests that empirical money demand estimations based on a model like (1) are likely to be unstable.

In first preliminary regressions we have experimented with a variety of variables that capture these macroeconomic influences. For each individual estimation we calculated the average rate of inflation and its standard deviation for the period over which the model was estimated. The same was also done for the average level and the standard deviation of the short-term interest rate and for the change of the effective exchange rate. In addition we also constructed variables for the (PPP value) of real per capita GDP. First preliminary results (not shown) show that the size of the income elasticities for narrow money depend negatively on the inflation rate, thus providing support to the view that individuals economize on their money holdings when inflation increases. Furthermore, the share of non-cash payments (proxied by the number of debit and credit cards per 1000 inhabitants) is negatively correlated with income elasticty estimates.[31] For broad money, the standard deviation of inflation (as a measure of uncertainty or instability) seems to exert a negative impact on the size of income elasticities. However, this finding is driven by a few countries with a high standard deviation of the inflation rate. For the majority of observations, we find no significant influence of macroeconomic variables on the income elasticities of M3. Thus, for broad money the variation in the estimation across studies thus seems to be partly due to differences in the specification and in data usage (as shown in Table 4) whereas differences in the economic structure of the countries seem to be of less importance.

The macroeconomic environment in the individual observation period could, however,

[31] There are no time series available on variables proxying non-cash payments. Thus, this finding is based on a low number of observations.

have an impact on the precision with which the money demand functions are estimated. A more volatile environment probably causes more variable and unpredictable money holding behavior, larger short-run fluctuations and on the total less reliable relations. An additional problem concerning the precision of estimates (already mentioned in section 3.3.4) was observed by L. Ball for the US. "Through the early 1980s, output and the interest rate follow similar upward trends, and so it is difficult to separate their effects on money demand. In other words, there is a collinearity problem." (Ball 2001, 32). This implies that during periods that are characterized by a high correlation between income and interest rates (the two most important components of money demand estimations) the precision of the estimates should be lower. We have therefore also constructed a variable that measures the (absolute value) of the correlation between the two variables.

In Table 7 we regress the precision of income elasticity estimates (measured by the t-value) on a set of variables related to the econometric method and to a set of macroeconomic variables.[32] Interestingly the hypothesis is confirmed that a more volatile macroeconomic environment (proxied by the coefficient of variation) leads to less precise estimates and the same is also true for the correlation between the interest rates and the level of income thus confirming the observation made by L. Ball for a completely different sample and applying a different method. In addition models that include a larger number of observations seem to lead to more precise estimates, again the result one would expect. This is only a first step to approach the issue of stablity in the meta-analytical framework. Our conclusion thus far is that more precise estimates (and maybe also more stable money demand functions) are produced when an economy is in a more stable macroeconomic enviroment.

6 Conclusion

In this paper we deal with the question whether and how the wide diversity of empirical money demand estimations can be explained by various characteristics of the studies. The

[32]We have also experienced with different measures for the precision including the square root of the t-value and the p-value which does not change the results in a qualitative manner.

variety of point estimates for the income elasticity is a well-documented fact from older surveys on empirical money demand studies and interestingly some of our results (e.g. concerning the role of broader monetary aggregates) are almost identical to observations made there (cf. Fase 1994, Laidler 1993) despite completly different samples of papers and despite the fact that in our sample most studies use modern cointegration techniques while before the surveys were dominated by partial adjustment models, etc.

In trying to explain the wide variety of estimates we extend, however, the older survey literature in various dimensions. First, we also take the precision of the estimates into consideration since the variability of the estimates could only be apparent and reflect the wide underlying distribution of uncertainty of estimation. Our analysis shows, however, that this issue does not seem to be at the root of the problem since point estimates are in general rather precise. Next, we perform a meta-analysis of almost 500 empirical money demand studies to investigate whether different characteristics might play a role for the variation. We find that specific features of the individual studies help to explain part of the considerable differences in the empirical results. In particular, we show that the estimations for the income elasticity of money demand are systematically and significantly higher if broader definitions for the monetary aggregate are used. The inclusion of variables like wealth and financial innovation on the other hand tend to be associated with lower estimates. The results for the use of different scale variables, the use of different econometric methods and various additional details of the specification are less clear-cut. Finally, we find that the precision of the estimates increases if the observation period was characterized by a rather stable macroeconomic environment and if the income and the interest variables are not too highly correlated. Our overall conclusion, however, is that the wide variety of estimated income elasticities can only be partly attributed to the imprecision of estimation, differences in the study characteristics and to different macroeconomic environments.

These results imply that it does not seem to be very likely that open questions in the field of theoretical money demand studies (concerning, e.g., the size and long-term constancy of the income elasticity) are resolved by turning to empirical estimations. Also, the results do not give an direct and straightforward answer to the question what constitutes

a "best practice" money demand estimation. From the point of view of monetary policy, finally, there are some potential implications for the choice of an optimal monetary strategy, an issue that has gained attention over the recent years due to the formation of the European Monetary Union. An open question, e.g., is, whether pure inflation targeting is the best strategy to pursue the ultimate objective of price stability or whether monetary targeting, nominal income targeting or some hybrid strategy is preferable (cf., e.g., Bofinger 2001, chap. 8). Since the latter two policies are based on the assumption of stable and predictable money demand functions the results of the meta-analysis would not lend strong support for these strategies. Ultimately, however, such a choice has to be based on a wide variety of political and economic factors and a narrative or meta-analytical survey can only deliver one input for this important decision.

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Table 1: Meta-Independent Variables

Income Elasticity	=the point estimates of the income elasticities
Monetary Aggregates	
M0	= 1 ... if a study used M0 or MB
M1	= 1 ... if a study used M1
M2	= 1 ... if a study used M2
M2M	= 1 ... if a study used M2M (broader concept than M2 for the US)
MZM	= 1 ... if a study used MZM (broader concept than M2 for the US)
M3	= 1 ... if a study used M3
M4	= 1 ... if a study used M4
Money Broad	= 1 ... if a study used either M2, MZM, M2M, M3 or M4
Money Narrow	= 1 ... if a study used M1
Money Currency	= 1 ... if a study used M0
Nom. Money	= 1 ... if a study used nominal money as the dep. variable
Scale Variables	
GDP	= 1 ... if a study used either GDP, GNP or Net National Income as a scale variable
Consumption	= 1 ... if a study used either consumption, personal income or private GDP (GDP less government component) as a scale variable
Indices	= 1 ... if a study used either an index of industrial production or of coincident indicators as a scale variable
Expenditure	= 1 ... if a study used a measure of expenditures (real consumption expenditures, real total transactions, total final expenditures, etc.) as a scale variable
Data Frequencies	
Monthly Data	= 1 ... if a study used monthly data
Quarterly Data	= 1 ... if a study used quarterly data
Annual Data	= 1 ... if a study used annual data
Estimation Method	
ADL	= 1 ... if a study used a distributed lag estimation method
EG	= 1 ... if a study used the Engle-Granger estimation method
DOLS	= 1 ... if a study used the dynamic OLS or GLS estimation method
FMOLS	= 1 ... if a study used the fully modified OLS estimation method
CP	= 1 ... if a study used the Cooley-Prescott estimation method
Random Coeff.	= 1 ... if a study used the random coefficients estimation method
Spectral	= 1 ... if a study used the spectral regression method
Johansen	= 1 ... if a study used the Johansen system estimation method
CCR	= 1 ... if a study used the canonical correlation estimation method

Note: See continuation on next page.

Table 1: Meta-Independent Variables

Other Variables	
Dummies	= 1 ... if a study included at least one dummy variable as an explanatory variable
Wealth	= 1 ... if a study included a measure of wealth
Fin. Innov.	= 1 ... if a study included a measure of finnancial innovation
Time	=the sample mid-point year of a study
Precision	=the t-value of the estimated income elasticity (calculated under the null of a unitary income elasticity)
No. of Obs.	=the number of observations used for estimating income elasticities
No. of Years	=the number of years in the sample used for estimating income elasticities

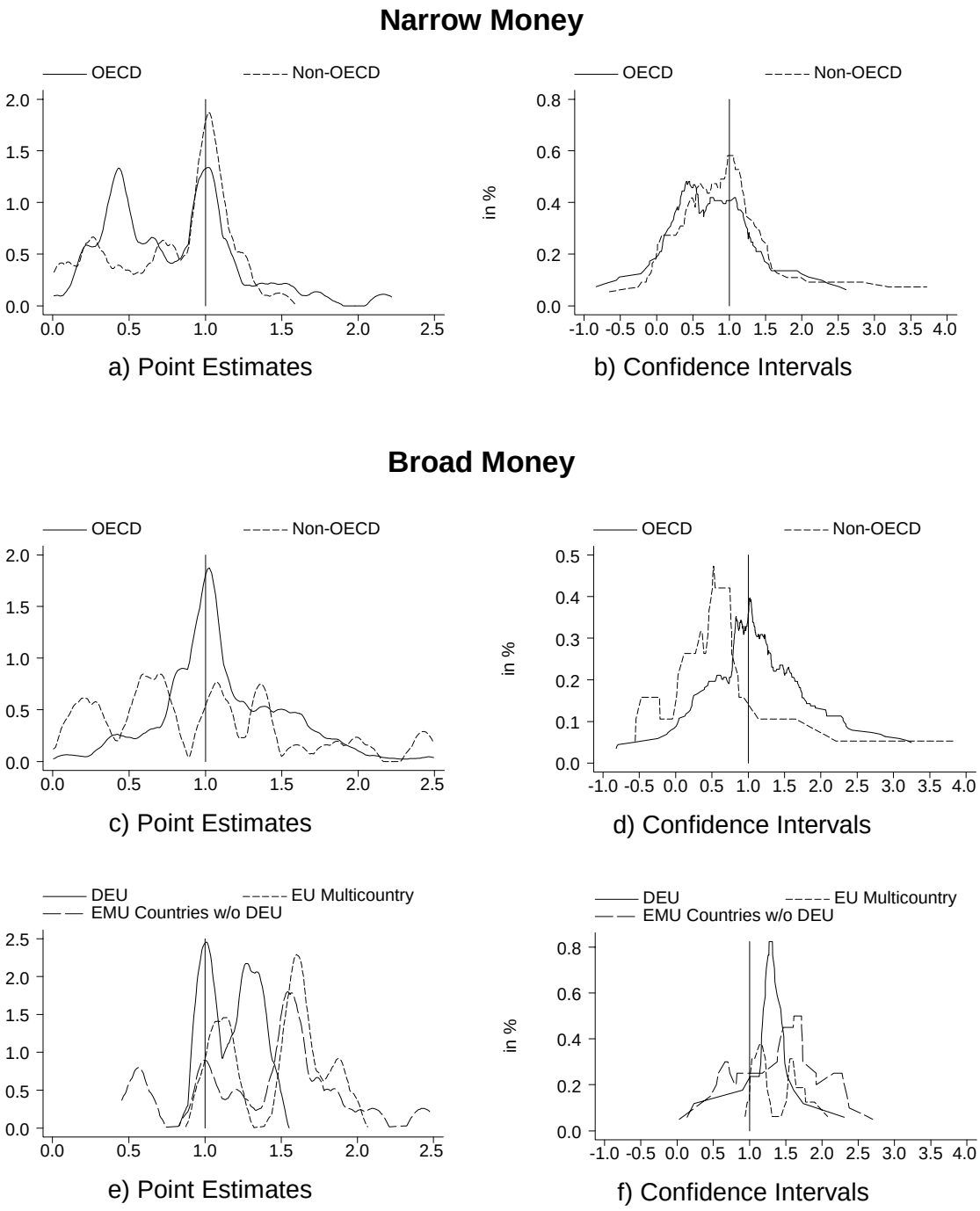

Figure 2: Smoothed Histogram of Point Estimates and Frequency Plots of Confidence Intervals for Different Countries

Table 4: Meta-Regression: All Observations

	Dependent Variable: Income Elasticity			
	(1)	(2)	(3) (1+no. of obs.)	(4) (1+no. of years)
Country Dummies	No	Yes	Yes	Yes
Monetary Aggregates				
M1	-0.097	0.016	0.031	-0.020
	(0.069)	(0.064)	(0.078)	(0.069)
M2	0.332***	0.439***	0.437***	0.483***
	(0.076)	(0.067)	(0.079)	(0.070)
M2M	0.346***	0.565***	0.548***	0.601***
	(0.123)	(0.098)	(0.093)	(0.104)
MZM	0.476***	0.664***	0.633***	0.682***
	(0.101)	(0.084)	(0.085)	(0.085)
M3	0.339***	0.348***	0.319***	0.271***
	(0.073)	(0.071)	(0.089)	(0.078)
M4	0.555***	0.659***	0.699***	0.720***
	(0.109)	(0.140)	(0.161)	(0.141)
Nom. Money	0.133**	0.141**	0.194**	0.215***
	(0.067)	(0.066)	(0.088)	(0.074)
Scale Variables				
Consumption	0.135**	0.309***	0.343***	0.291***
	(0.064)	(0.062)	(0.075)	(0.069)
Indices	0.007	0.226***	0.271***	0.215***
	(0.073)	(0.072)	(0.079)	(0.080)
Expenditure	-0.368***	-0.204***	-0.207**	-0.192**
	(0.089)	(0.076)	(0.093)	(0.089)
Wealth	-0.453***	-0.630***	-0.543***	-0.599***
	(0.128)	(0.133)	(0.178)	(0.157)
Fin. Innov.	-0.533***	-0.034	0.007	-0.010
	(0.112)	(0.148)	(0.152)	(0.159)
Time	-0.006***	-0.015***	-0.015***	-0.016***
	(0.002)	(0.002)	(0.002)	(0.002)

Note: Standard errors in parentheses. *** (**) [*] indicate significance at a 1% (5%) [10%] level. See continuation on next page.

Table 4: Meta-Regression: All Observations

	Dependent Variable: Income Elasticity			
	(1)	(2)	(3) (1+no. of obs.)	(4) (1+no. of years)
Monthly Data	-0.349***	-0.417***	-0.390***	-0.415***
	(0.076)	(0.063)	(0.063)	(0.065)
Annual Data	-0.035	-0.217***	-0.123	-0.178***
	(0.064)	(0.067)	(0.090)	(0.065)
Dummies	0.123***	0.090**	0.083*	0.117***
	(0.044)	(0.038)	(0.045)	(0.038)
Estimation Method				
ADL	0.067	-0.107**	-0.098*	-0.110**
	(0.050)	(0.043)	(0.055)	(0.045)
EG	-0.111*	-0.023	-0.017	-0.058
	(0.062)	(0.066)	(0.094)	(0.068)
DOLS	-0.085	-0.014	-0.024	-0.003
	(0.063)	(0.049)	(0.058)	(0.042)
FMOLS	0.134**	0.046	0.028	0.000
	(0.065)	(0.052)	(0.066)	(0.051)
CP	-0.299**	-0.277**	-0.252	-0.284
	(0.133)	(0.117)	(0.187)	(0.173)
Random Coeff.	-0.577***	-0.645***	-0.670***	-0.689***
	(0.135)	(0.107)	(0.116)	(0.062)
Spectral	-0.433**	-0.173	-0.218	-0.155
	(0.169)	(0.128)	(0.205)	(0.100)
C	13.440***	31.397***	30.918***	32.942***
	(4.136)	(3.714)	(4.382)	(3.026)
$\bar{R}^2$	0.39	0.67		

Note: Standard errors in parentheses. *** (**) [*] indicate significance at a 1% (5%) [10%] level. Column (1) estimated by OLS, columns (2)-(3) by weighted LS. See the Appendix for a definition of variables.

Table 2: Descriptive Statistics for Income Elasticities

	Mean	Std. Dev.	Min.	Max.	Obs.
All Observations					
Total	1.06	2.10	-14.11	44.79	559
OECD Countries	1.09	2.32	-14.11	44.79	435
Non-OECD Countries	0.95	0.96	-2.98	5.55	124
USA	0.83	1.23	-14.11	5.81	227
Non-USA	1.22	2.51	-2.98	44.79	332
DEU	1.19	0.24	0.60	2.17	47
EU Multicountry	1.42	0.64	0.86	5.04	45
<23 Models	1.20	2.40	-1.06	44.79	361
Adjusted Sample					
Total	0.97	0.41	0.01	2.46	469
OECD Countries	1.00	0.38	0.12	2.10	373
Non-OECD Countries	0.89	0.48	0.01	2.46	96
USA	0.84	0.31	0.18	1.89	200
Non-USA	1.07	0.44	0.01	2.46	269
DEU	1.16	0.19	0.60	1.52	43
EU Multicountry	1.34	0.32	0.86	1.96	44
<23 Models	1.08	0.42	0.02	2.46	299

Note: The table summarizes descriptive statistics for the estimated income elasticities. "Adjusted Sample" denotes the sample obtained after eliminating the 5% highest and lowest income elasticities as well as all income elasticities that were constrained to be one (without statistical testing). "EU Multicountry" denotes a sample consisting of studies about European countries where the individual countries were aggregated. For a definition of the variables see the Appendix.

Table 3: Characteristics of the Studies by Sub-Groups,

	Total	OECD	Non-OECD	USA
M0	6	3	20	2
M1	31	28	46	30
M2	29	31	23	48
M2M	3	3	0	6
MZM	6	8	0	15
M3	22	24	11	0
M4	3	4	0	0
Sum	100	100	100	100
GDP	62	60	67	29
Consumption	16	17	9	32
Indices	20	19	22	36
Expenditure	3	3	2	4
Sum	100	100	100	100
Monthly Data	27	31	10	58
Quarterly Data	57	53	73	21
Annual Data	16	16	17	22
Sum	100	100	100	100
ADL	16	14	22	5
EG	10	5	33	3
DOLS	8	10	1	10
FMOLS	7	9	0	2
CP	1	0	7	0
Random Coeff.	2	2	0	3
Spectral	1	1	0	2
Johansen	54	58	36	74
CCR	1	1	0	2
Sum	100	100	100	100
Nom. Money	7	9	0	1
Wealth	1	2	0	0
Fin. Innov.	2	0	10	0
Dummies	20	21	15	4

Note: The table shows the frequencies (in percent) of the various characteristics of the studies. For a definition of the variables, see the Appendix.

Table 5: Predicted Income Elasticities

	Narrow Money	Broad Money
Total	0.93	1.30
OECD	0.91	1.28
Non-OECD	0.94	1.31
US	0.61	1.19
Non-US (but OECD)	0.95	1.29
DEU[1]	1.07	1.18
EU Multicountry	1.09	1.40
EMU Countries w/o DEU		1.38

Note: The table shows the means of the predicted values for individual countries or country groups. The predicted values are calculated under the assumption that the model is estimated in real terms, with GDP as the scale variable, without wealth, finnancial innovation and dummies, with quarterly data and with Johansen's method.

[1] For narrow money 8 observations only.

Table 6: Meta-Regression: Different Subsamples

	Dependent Variable: Income Elasticity							
	(1) OECD	(2) Non-OECD	(3) USA	(4) Non-USA	(5) DEU	(6) EU Multicountry	(7) Johansen	(8) <23 Models
M1	0.014	0.058	-0.014	0.021		0.365	0.001	0.022
	(0.099)	(0.087)	(0.122)	(0.085)		(0.231)	(0.092)	(0.075)
M2	0.559***	0.245***	0.530***	0.366***			0.367***	0.441***
	(0.100)	(0.084)	(0.115)	(0.091)			(0.092)	(0.075)
M2M	0.666***		0.633***				0.503***	
	(0.127)		(0.137)				(0.119)	
MZM	0.747***		0.718***				0.569***	
	(0.111)		(0.124)				(0.103)	
M3	0.321***	-0.072		0.285***	0.200	0.546***	0.291**	0.263***
	(0.106)	(0.133)		(0.090)	(0.180)	(0.185)	(0.114)	(0.084)
M4	0.741***			0.487***			0.890***	0.715***
	(0.161)			(0.161)			(0.193)	(0.153)
Nom. Money	0.206***		0.462**	0.048	-0.385	-0.372**	0.142	0.159*
	(0.079)		(0.189)	(0.105)	(0.336)	(0.176)	(0.106)	(0.084)
Consumption	0.261***	0.392***	0.363***	0.415**			0.328***	0.284***
	(0.081)	(0.144)	(0.108)	(0.200)			(0.101)	(0.081)
Indices	0.181*	0.303	0.282**	0.219			0.257**	0.146
	(0.093)	(0.184)	(0.116)	(0.235)			(0.111)	(0.228)
Expenditure	-0.126		-0.026	-0.271**			0.044	-0.163*
	(0.102)		(0.177)	(0.132)			(0.165)	(0.098)
Wealth	-0.600***			-0.576***	-0.025			-0.551***
	(0.162)			(0.158)	(0.214)			(0.167)
Fin. Innov.	-0.206	0.061		0.003			-0.467	-0.016
	(0.313)	(0.163)		(0.173)			(0.337)	(0.180)

Note: Standard errors in parentheses. *** (**) [*] indicate significance at a 1% (5%) [10%] leve. See continuation on next page.

Table 6: Meta-Regression: Different Subsamples

	Dependent Variable: Income Elasticity							
	(1) OECD	(2) Non-OECD	(3) USA	(4) Non-USA	(5) DEU	(6) EU Multicountry	(7) Johansen	(8) <23 Models
Time	-0.016***	-0.014	-0.015***	-0.012***	-0.009	0.016	-0.020***	-0.013***
	(0.002)	(0.020)	(0.002)	(0.004)	(0.018)	(0.020)	(0.002)	(0.003)
Monthly Data	-0.407***	-0.594***	-0.407***	-0.581**			-0.246***	-0.398***
	(0.073)	(0.169)	(0.070)	(0.236)			(0.087)	(0.141)
Annual Data	-0.196***	0.335	-0.023	-0.003			-0.121	0.083
	(0.074)	(0.442)	(0.104)	(0.156)			(0.106)	(0.130)
Dummies	0.103**	0.289**	0.118	0.111**	-0.046	-0.015	0.132**	0.104**
	(0.040)	(0.130)	(0.106)	(0.044)	(0.070)	(0.139)	(0.063)	(0.041)
ADL	-0.109**	-0.126	-0.097	-0.124**	-0.107	-0.170		-0.114**
	(0.054)	(0.078)	(0.114)	(0.053)	(0.082)	(0.128)		(0.053)
EG	-0.037	-0.022	-0.163	-0.021	0.258			-0.066
	(0.085)	(0.121)	(0.101)	(0.097)	(0.216)			(0.102)
DOLS	0.018	-0.052	-0.024	0.028	0.087			0.006
	(0.045)	(0.152)	(0.061)	(0.061)	(0.113)			(0.057)
FMOLS	0.008		-0.198*	0.060	0.004	0.001		0.060
	(0.054)		(0.104)	(0.058)	(0.097)	(0.133)		(0.061)
CP		-0.335**		-0.333*				
		(0.163)		(0.190)				
Random Coeff.	-0.693***		-0.683***	-0.997***				-0.765***
	(0.064)		(0.064)	(0.189)				(0.071)
Spectral	-0.128		-0.191*					
	(0.104)		(0.104)					
C	32.640***	27.639	30.566***	25.634***	18.939	-30.577	39.936***	27.694***
	(3.272)	(39.155)	(3.593)	(7.493)	(36.106)	(40.540)	(4.622)	(5.923)
Obs.	373	96	200	269	43	44	251	299

Note: Standard errors in parentheses. *** (**) [*] indicate significance at a 1% (5%) [10%] level. All estimations contain country dummies and are weighted by the inverse of the number of years. See the Appendix for a definition of variables. "EU Multicountry" denotes a sample consisting of studies about European countries where the individual countries were aggregated.

Table 7: Regression with Macro Variables

	Dependent Variable: t-Values		
	(1) All	(2) w/o A28	(3) Non-USA
Number Obs.	0.029*	0.175***	0.206***
	(0.015)	(0.055)	(0.068)
Broad Money	11.916***	9.427**	11.122**
	(3.297)	(3.664)	(4.887)
Currency	5.939	8.021*	8.347
	(4.216)	(4.253)	(5.529)
ADL	-5.261	-2.089	-0.216
	(3.631)	(3.512)	(5.166)
EG	-0.335	8.520*	8.907
	(5.160)	(5.093)	(7.371)
DOLS	21.419*	22.054**	25.063*
	(11.009)	(11.079)	(14.218)
FMOLS	0.416	3.497	2.100
	(4.012)	(4.396)	(5.734)
CP	-1.000	6.669	7.565
	(4.075)	(5.164)	(7.634)
SPECTRAL	0.125	4.442	
	(3.243)	(3.565)	
Dummies	0.596	1.123	0.877
	(5.112)	(5.375)	(7.245)
CV INT. RATE	-36.208***	-40.717***	-39.384***
	(11.311)	(12.487)	(13.416)
CV GROWTH RATE	1.550**	2.267***	2.180**
	(0.721)	(0.860)	(0.933)
COR(IR,GDP)	-13.971**	-22.091**	-19.127*
	(5.982)	(8.578)	(10.978)
Dummies	0.596	1.123	0.877
C	24.199***	14.804**	10.400
	(6.250)	(6.366)	(9.819)
R^2	0.26	0.38	0.39
Obs.	229	125	98